A CORDLESS TWO-MOTOR VACUUM CLEANER

The invention relates to a cordless vacuum cleaner that cleans very effectively.

More precisely, the invention relates to a cordless vacuum cleaner comprising a structure mounted on transport members, a turbine carried by the structure for creating suction in a particle collector via a filter membrane, a beater brush secured to the structure and connected to said collector via a first duct, a suction device suitable for being connected to said collector via a flexible second duct, means for selectively putting said first duct or the coupling for said second duct into communication with said collector, a first motor (M1) for driving said turbine, a second motor (M2) for driving the beater brush, an electrical circuit for powering said motors from a battery carried by said structure, and a three-position control member serving in a first position to stop the motors, in a second position to cause the first motor (M1) to operate, and in a third position to cause both motors (M1, M2) to operate simultaneously.

Such a vacuum cleaner having two direct current (DC) motors is described in WO 03/003896. In that type of vacuum cleaner, the two motors are connected in parallel to the terminals of the battery and each of them is controlled by a two-position switch. The performance of the turbine depends on the extent to which the filter membrane is clogged. When the collector is filled with particles, cleaning effectiveness is greatly decreased. To remedy that, the motors driving the turbine and the beater brush are fitted with electronic circuits that are complex and expensive.

One of the objects of the invention is to propose a cordless vacuum cleaner of the type mentioned in the introduction of the present specification, in which the voltage applied to the terminals of the two motors adapts automatically when operating in beater mode, as a

function of the degree to which the filter membrane is clogged, without the presence of electronic circuits.

The invention achieves this object by the fact that the motors are electrically powered in such a manner that when the control member is in the third position, the two motors are powered in series.

Surprisingly, it is found that when the collector becomes clogged, the voltage across the turbine drive motor increases and the voltage across the beater brush decreases.

Advantageously, the control member comprises a knob mounted to turn on the structure, said knob presenting two cam paths, each suitable for causing a respective switch to open or close, namely a first switch S1 which, when in the closed position, powers both motors, and a second switch S2 which, when in the closed position, short-circuits the second motor.

Another object of the invention is to provide a cordless two-motor vacuum cleaner in which the three-position control member also actuates the means for selectively putting the first duct or the coupling of the second duct into communication with the collector.

This other object is achieved according to the invention by the fact that the control member comprises a knob mounted to turn on the structure, said knob presenting the means for selectively putting the first duct or the coupling for the second duct into communication with the collector, and further presenting two cam paths each suitable for controlling the opening and the closing of a respective switch, namely a first switch which, when in the closed position, powers at least the first motor, and a second switch controlling the operation of the second motor.

Under such circumstances, the electrical circuit for powering the motors is made in such a manner that in the third position of the control member, both motors are powered in parallel, the second switch controlling a

microprocessor which manages the power delivered by the two motors.

According to another advantageous characteristic of the invention, the knob further presents the means for selectively putting the first duct or the coupling for the second duct into communication with the collector.

Preferably, the knob comprises a cylindrical body having a bent channel formed therein opening out firstly in the rear face of said knob and secondly to one side of its periphery, said body being received in a cylindrical cavity formed in the structure, the bottom of said cavity including an orifice communicating with the collector, and the periphery of said cavity presenting two diametrically opposite orifices into which there open out respectively the first duct and the coupling for the flexible duct.

The following dispositions are preferably also adopted. The cam paths are formed at the periphery of the body and are disposed in parallel planes perpendicular to the axis of the knob.

The first cam path which controls opening and closing of the first switch (S1) presents two diametrically opposite protuberances, and the second cam path which controls opening and closing of the second switch (S2) presents only one protuberance.

The protuberance of the second cam path and the protuberances of the first cam path are disposed in a plane that contains the axis of rotation of the knob.

The two switches (S1, S2) are in radially opposite regions of the cavity in which the knob is received.

The protuberances are disposed in the plane of symmetry of the bent channel.

Other advantages and characteristics of the invention appear on reading the following description made by way of example and with reference to the accompanying drawings, in which:

· Figure 1 is a profile view in section of a vacuum cleaner in accordance with the invention;

· Figure 2 shows the electrical circuit diagram of the prior art;

· Figure 3 shows the electrical circuit diagram of the invention;

· Figure 4 is a section on a plane of symmetry through the knob which allows changeover from beater mode to suction mode, and enables the motors received in a cavity of the frame to be stopped; and

· Figure 5 is a section on line V,V of Figure 4.

The vacuum cleaner shown in Figure 1 comprises a structure 1 mounted on transport members R, and carrying a turbine T driven by a first electric motor M1 and serving to create suction in a particle collector by acting through a filter membrane M. The turbine T and the first motor M1 are received in a chamber k, and under such circumstances the collector is constituted by a flexible bag S having an air-permeable wall that is enclosed in a compartment K whose top and sides are defined by a leakproof rigid wall and whose bottom is defined by the membrane M that provides separation relative to the suction chamber k. The membrane M may form part of the bag S. The turbine T applies suction to the compartment K and evacuates the air it sucks in via a volute 11 which leads into a chamber 12 communicating with the outside through orifices.

At its bottom end, the structure 1 is provided with a beater brush B in the form of a rotary brush driven by a second motor M2.

Reference E designates a rechargeable battery housed in a case A disposed under the turbine T and serving to feed direct current to the two motors M1 and M2.

The bag S is held inside the compartment K by means of projections D secured to the inside wall of said compartment K and it includes an opening 20 that fits on an outlet 21 of a device 30 enabling the inside of the

bag S to be put selectively into communication either with a duct C connected to the beater brush B, or else with a coupling 40 suitable for coupling to one end of a flexible duct 41 which is fitted at its other end with a suction nozzle 42.

Reference N designates a handle of the vacuum cleaner that is in the form of an upside-down U shape, and it may be slidably mounted on the structure.

Figure 2 shows the electric power supply circuits for the two motors M1 and M2 in the prior art.

The two motors M1 and M2 are connected in parallel. A general first switch S1 serves to feed electricity to the first motor M1 for driving the turbine T, both in the beater mode of operation and in the suction mode of operation. A second switch S2, when in its closed position, serves to feed electricity to the second motor M2 for driving the beater brush B, providing the first switch S1 is also in its closed position.

Figure 3 shows the electrical wiring of the vacuum cleaner 1 in a first aspect of the invention, as described in detail below.

The two motors M1 and M2 are connected in series and the first switch S1, when in the closed position, enables electricity to be fed to both motors M1 and M2. The second switch S2 is mounted in the circuit in such a manner that when in its closed position it shunts the motor M2 for driving the beater brush B.

When the vacuum cleaner is used in beater mode, the first switch S1 is in the closed position and the second switch S2 is in the open position. The sum of the voltages across the motors M1 and M2 is thus equal to the voltage across the battery E.

When the vacuum cleaner is used in suction mode, the first switch S1 is in the closed position and the second switch S2 is also in the closed position. The second motor M2 is then shunted or short-circuited. The voltage

applied to the first motor M1 is equal to the voltage of the battery E.

When the vacuum cleaner is at rest, the first switch S1 is in the open position. The member for controlling the two switches S1 and S2 ensures that in the rest or stop position, the second switch S2 is likewise in the open position.

Tables 1 and 2 below show examples of the voltages U applied to the motors M1 and M2, together with the corresponding current I (amps), power P (watts), suction DP (mm of water), and turbine speed N (in revolutions per minute (rpm)), both when the bag S is clean (Table 1) and clogged (Table 2) for operation in beater mode.

Table 1

	U (V)	I (A)	P (W)	DP (mm H_2O)	N (rpm)
M1	6.0	9.0	54	150	10,000
M2	6.0	9.0	54		
E	12.0	9.0	108		

Table 2

	U (V)	I (A)	P (W)	DP (mm H_2O)	N (rpm)
M1	8.0	8.0	64	300	14,000
M2	4.0	8.0	32		
E	12.0	8.0	96		

It can be seen that when the bag S is clogged, the voltage applied to the motor M1 increases while the voltage applied to the motor M2 decreases. Thus, the proposed wiring makes it possible automatically to increase the power of the first motor M1 driving the turbine T as a function of the extent to which the bag S is filled.

Table 3 below shows the same values, but when operating in suction mode, when the motor M1 is the only

motor being powered electrically, both for a clean bag S and a clogged bag.

Table 3

		U (V)	I (A)	P (W)	DP (mm H_2O)	N (rpm)
Clean bag	M1	12.0	20.0	240	250	15,000
Clogged bag	M1	12.0	10.0	120	550	19,000

It can be seen that in this mode of operation, the suction created by the turbine increases greatly when the bag is full.

Figures 4 and 5 show the device 30 that enables the inside of the bag S to be put selectively into communication either with the duct C or with the coupling 40 for the flexible duct 41. This device 30 is in the form of a knob 31 mounted to turn about an axis of rotation 32 that is coaxial with the outlet 21 onto which the opening 20 of the bag S is mounted. The bottom 32 comprises a cylindrical body 33 of axis 32 which is received in a cylindrical cavity 34 formed in the structure 1. The coupling 35 for the duct C and the coupling 40 for the flexible duct 41 of the suction device 42 open out into the cylindrical cavity 34 in opposite directions perpendicular to the axis X. The cylindrical body 33 has a bent channel 36 with one end opening out into the outlet 21 and with its other end opening out to the periphery of the cylindrical body 33 and capable of being put into register with one or other of the couplings 35 and 40 by turning the knob 31 about the axis 32.

On its outside face, the knob 31 also presents handle means 37 in the form of a lug for enabling said knob 31 to be turned manually about the axis 32.

Close to its inside end pressing against the bottom of the cavity 34, the cylindrical body 33 presents a zone 38 of diameter that is smaller than that of the other

portion of the body 33, and that presents at its periphery two cam paths 39a and 39b lying in parallel planes perpendicular to the axis 32, with the first path 39a serving to control the first switch S1, and the second path 39b serving to control the second switch S2, these two switches S1 and S2 being mounted in housings provided at the periphery of the cylindrical cavity 34 and being substantially diametrically opposite.

The first cam path 39a is formed by the cylindrical periphery of the zone 38 and by two protuberances 44 and 45 that are diametrically opposite, while the second cam path 39b is formed by the cylindrical periphery of the zone 38 and by a single protuberance 46 disposed in the immediate vicinity of the protuberance 45. The protuberances 44, 45, and 46 are preferably situated in the plane of symmetry of the knob 31 that contains the mid-line of the bent channel 36.

In the position of the knob 31 that is shown in Figures 4 and 5, the switch S1 is closed, the switch S2 is closed, and the flexible duct 41 is in communication with the inside of the bag S via the coupling 40, the bent channel 36, and the outlet 21. In this configuration, the first motor M1 is fed with electricity, the second motor M2 is shunted, and the vacuum cleaner operates in suction mode.

If the knob 31 is turned through 180°, in either direction about the axis 32, the switch S1 is closed, the switch S2 is open, and the duct C is in communication with the inside of the bag S via the coupling 35, the bent channel 36, and the outlet 21. The two motors M1 and M2 are thus connected in series and powered by the battery E. The vacuum cleaner then operates in beater mode.

When on turning the knob 31 about the axis 32, the protuberances 44, 45, and 46 move away from the vertical position, both switches S1 and S2 open and the motors M1 and M2 stop since they are no longer fed with

electricity. The vacuum cleaner is then in stop or rest mode.

It should be observed that the knob 31 can easily be withdrawn from its housing, thereby necessarily opening the switches S1 and S2 and stopping the motors M1 and M2. This disposition makes it easy to clean the bent channel 36 in the event of it becoming jammed.

When both motors M1 and M2 are powered in parallel, as shown in Figure 2, the device 30 enabling the inside of the bag S to be put selectively into communication either with the duct C or with the coupling 40 for the flexible duct 41 is identical to that shown in Figures 4 and 5 and described above.

The switch S1 in the closed position then causes electricity to be fed to an electronic power circuit including a microprocessor that manages the amount of electrical power delivered to the motors M1 and M2 as a function of whether the switch S2 is open or closed.